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ER/WM&I DDT

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RFCA Milestones M4 and M5
Performance Measure RMRS 99/00-MIS-08
Source/Driver: (Name & Number from ISP, RFCA Milestone, Mgmt. Action, Corres. Control, etc.)

Closure #: (Outgoing Correspondence Control #, if applicable)

October 7, 1999
Due Date

A. L. Primrose
Originator Name

J. H. Moore
Quality Assurance Approval

J. E. Law
Contractor Manager(s)

Lane Butler
Kaiser-Hill Program Manager(s)

Alan Rodgers
Kaiser-Hill Director

Document Subject:

TRANSMITTAL OF THE COMPLETION REPORT FOR RMRS-99/00-MIS-08 AND THE CLOSEOUT REPORTS FOR THE EAST TRENCHES PLUME RF/RMRS-99-443.UN AND SOLAR PONDS PLUME PROJECT RF/RMRS-99-444.UN - JEL-093-99

KH-00003NS1A October 7, 1999

Discussion and/or Comments:

Attached is the Completion Report for Performance Measure RMRS-99/00-MIS-08 and ten (10) copies each of the Closeout Reports for the East Trenches Plume Project (RF/RMRS-99-443.UN) and Solar Ponds Plume Project (RF/RMRS-99-444.UN). The closeout reports were reviewed previously by Kaiser-Hill and all comments have been incorporated. These document completion of RFCA Milestones M4 and M5.

If you have any questions concerning this transmittal, please contact Annette Primrose at extension 4385.

ALP

Attachments:
As Stated (10)

cc:
M. L. Bemski
A. C. Crawford (w/o Attachment)
J. E. Law (w/o Attachment)
T. M. Lindsay
S. H. Mills
M. K. Pepping
RMRS Records
Admin Record

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ADMIN RECORD

1/27

DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE
CEX-010-98

I101-B-000075

RF/RMRS-99-443.UN

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EAST TRENCHES PLUME PROJECT

CLOSEOUT REPORT
FISCAL YEAR 1999

Rocky Flats Environmental Technology Site

October 7, 1999

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FIGURES

ACRONYM LIST

CDPHE	Colorado Department of Public Health and Environment
CWTF	Consolidated Water Treatment Facility
DOE	Department of Energy
EPA	Environmental Protection Agency
HDPE	High-Density Polyethylene
IHSS	Individual Hazardous Substance Site
pCi/g	Picocuries per gram
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services
µg/l	Micrograms per liter
VOC	Volatile Organic Compound

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1.0 INTRODUCTION

This report documents the completion of the East Trenches Plume Project at the Rocky Flats Environmental Technology Site (RFETS) and will be finalized when as-built drawings are available. This project was conducted in accordance with the Final Proposed Action Memorandum for the East Trenches Plume (RMRS 1999).

As a result of past waste storage practices at the East Trenches, volatile organic compounds are present in groundwater in excess of the Action Level Framework Tier I level groundwater concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE 1996). The contaminated groundwater has migrated away from source areas towards South Walnut Creek.

As defined in the Proposed Action Memorandum (RMRS 1999), the objectives of this project were to:

- Intercept and treat volatile organic compound (VOC)-contaminated groundwater at the distal (northern) end of the East Trenches Plume.
- Protect surface water and reduce the VOC-contaminant mass loading in surface water, to the extent practicable.
- Install an easily accessible system to reduce operation and maintenance costs and to easily replace media when necessary.
- Minimize the impact to Preble's Meadow Jumping Mouse during construction.
- Avoid depletion of waters to South Walnut Creek.

2.0 PROJECT BACKGROUND

The plume of VOC-contaminated groundwater is derived from the East Trenches area which includes Trench T-3 (Individual Hazardous Substance Site [IHSS] 110) and T-4 (IHSS 111.1). These disposal trenches were used between 1964 and 1967 for disposal of sanitary sewage sludge contaminated with low levels of uranium and plutonium, VOCs and miscellaneous waste (DOE 1992). In 1996, these trenches were remediated as part of an accelerated source removal action (RMRS 1996).

A component of the plume is also believed to be derived from the VOC contamination at the 903 Pad and Lip Area where drums containing plutonium and uranium contaminated oils and solvents were stored from the summer of 1958 to January 1967 (RMRS 1997). A remedial action is planned to begin in 2001 to remediate the radiologically- and VOC-contaminated soils in this area.

Groundwater flow in the area is complex and is primarily controlled by bedrock surface features, interactions between geologic units, and variations in saturated thicknesses. The Arapahoe No. 1 Sandstone is present beneath the East Trenches source area and is the preferential pathway for contaminated groundwater to flow towards South Walnut Creek. The Arapahoe No. 1 Sandstone subcrops into the colluvium at a seep complex near South Walnut Creek. Much of the groundwater flow and contaminant flux for the East Trenches Plume is through the Arapahoe No. 1 Sandstone.

The primary contaminants in the East Trenches groundwater plume are VOCs derived from the Trench 3 and Trench 4 source areas. VOC contamination has been detected in the groundwater and in seeps at South Walnut Creek. In the source area, semi-volatiles, petroleum hydrocarbon compounds, and uranium-238 at concentrations up to 3,240 picocuries/gram (pCi/g) were also detected in the soils (RMRS 1996). At the collection system location, trichloroethene was the predominant contaminant found in groundwater with the highest concentration of 6,800 micrograms/liter (μg/l) in Well 23197. The other major contaminants included 1,1-trichloroethane at 730 μg/l in well 22697, and carbon tetrachloride at 460 μg/l in well 22997.

3.0 INSTALLATION OF THE SYSTEM

A groundwater collection and treatment system was installed to capture, redirect, and treat contaminated groundwater within treatment cells containing zero-valent iron. System installation began in February 1999 and was completed on September 23, 1999. The collection system was the last component completed. The system was partly operational after completion of the treatment system. At that time, the collected groundwater was routed through treatment cells containing zero-valent iron.

The groundwater collection system extends approximately 1,200 feet in an east-west direction (Figure 1) and captures the majority of the contaminated groundwater plume. To install the collection system, an excavation was dug at a variable depth of approximately 16 to 26 feet below ground surface, at least 6 inches, and on average, 3 feet into claystone. An impermeable barrier was installed that consists of 80-mil high-density polyethylene (HDPE) panels fitted with an interlocking strip on each side. A hydrophilic cord was threaded through the entire length of the interlock. This cord swells when wet, further sealing the panels together. These panels are 15 feet wide and of a variable height depending on the installation depth.

The bottom of the collection trench was filled with bentonite pellets to limit bypass or leakage. On the upgradient side of the barrier, approximately one foot of sand was placed over the bentonite to bed the collection line. The four-inch perforated HDPE groundwater collection line was placed on the sand, and piped to a central collection sump. Sand was then placed around and several feet above the horizontal collection line. The trench was then backfilled. Three piezometers were installed in the collection trench for monitoring of water levels within the collection system. Figure 2 shows the details of the trench construction.

A collection sump was installed at the eastern end of the collection system to accumulate groundwater, and to allow fine-grained sediment to drop out. The collected groundwater flows by gravity from the collection sump through a 2-inch, non-perforated HDPE conveyance line to the two treatment cells.

The treatment system consists of two high-density polyethylene tanks containing reactive iron, which degrades the dissolved VOCs in the groundwater. The system utilizes iron to induce conditions where hydrogen is substituted for chlorine in the chlorinated VOCs. The end products of the process are completely dehalogenated hydrocarbons and non-toxic salts. The treatment cells are approximately 12 feet in diameter and 13 feet tall. Groundwater enters the cells at the top and percolates through the 6.5

feet of iron. There is one foot of granular material on the bottom of each treatment cell to disperse the groundwater. The upper foot of each cell is a 50/50 mixture of iron and pea gravel to simplify mechanical break-up of the expected crust formation.

The treatment cells are piped so that they can be run in serial or parallel (Figure 3). Water discharges from the base of the treatment cell to the next cell or to the metering manhole. The metering manhole contains a water flow meter to determine the volume of water treated, and is the effluent sample location. From the metering manhole, the treated water then discharges to groundwater through an infiltration gallery located adjacent to South Walnut Creek. However, for additional flexibility, the system allows discharge directly to surface water in South Walnut Creek, if needed. Reclamation of the disturbed areas and restoration of the B-Series Pond road took place after installation of the collection and treatment system.

Four downgradient monitoring wells monitor the performance of the system. One existing well is being used along with three additional wells installed as part of the system (Figure 1).

4.0 DEVIATIONS FROM THE DECISION DOCUMENT

Due to operational constraints and above average precipitation during installation of the East Trenches Plume Project, a field modification of the Proposed Action Memorandum Section 5.2.5-Construction Waters, was discussed with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE). This modification allowed construction waters at the East Trenches Plume Project to be discharged to the B-Series Ponds when large quantities of water generated during construction could not be effectively or safely collected and transferred to the Site's Consolidated Water Treatment Facility (CWTF). Water was primarily discharged to Pond B-2, however some water was also transferred to Pond B-1 to maintain a sufficient quantity of water in that Pond.

Figure 9 of the Decision Document (RMRS 1999) shows geotextile around the filter pack in the collection trench. The geotextile was removed when it was determined that it was not necessary.

Significant failure of the excavation occurred during installation of the collection system. This failure was due in part to well above average precipitation during installation of the collection system, which saturated and destabilized the excavation, and to a previously unidentified fault zone in the collection system area. Failure of the excavation resulted in damage and removal of several barrier panels. When continued installation of the collection system was not possible under existing conditions, a sand trench was installed along the planned location of the western half of the collection trench to drain the area. After the sand trench was completed, the barrier panels were installed starting at the western end of the collection trench. Solid steel plates were used to support the panels during installation instead of the previously used hollow frames. These solid plates were additionally braced by I-beams and, along with a modified trench box, limited excavation collapse.

Where the two portions of the collection trench met, it was not possible to interlock the panels due to the conditions. Therefore, a panel from the western leg of the collection trench was installed that overlaps the eastern leg of the collection trench by approximately 4 feet. The area between the two panels was filled with bentonite. The area behind the overlap in the panels was filled with bentonite to the top of the panels. In all, 5.5 supersacks of bentonite, each containing approximately 3,500 pounds, were utilized to seal the area where the two panels overlap.

The perforated collection pipe was broken in several places during installation. The pipe could not be repaired because the excavation could not be entered due to highly unstable conditions. A new section of pipe was placed adjacent to and overlapping the severed section, with both sections bedded in sand. Field observations during installation of the western leg of the collection trench indicated that this method worked very well for transporting the collected groundwater.

5.0 REFERENCES

DOE, 1992, *Final Historical Release Report for the Rocky Flats Plant*, 21100-TR-12501.01, Rocky Flats Plant, Golden, CO, July.

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO, July.

RMRS, 1996, *Completion Report for the Source Removal at Trenches T-3 and T-4 (IHSSs 110 and 111.1)*, RF/ER-96-0051, September.

RMRS, 1997, *Sampling and Analysis Plan for the Site Characterization of the 903 Drum Storage Area (IHSS 112), 903 Lip Area (IHSS 155), and Americium Zone,* RF/RMRS-97-084, January 1998 Rev.0.

RMRS, 1999, *Final Proposed Action Memorandum For The East Trenches Plume*, RF/RMRS-98-258.UN.

RF/RMRS-99-444.UN

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SOLAR PONDS PLUME PROJECT

CLOSEOUT REPORT
FISCAL YEAR 1999

Rocky Flats Environmental Technology Site

October 7, 1999

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FIGURES

ACRONYM LIST

CDPHE	Colorado Department of Public Health and Environment
DOE	Department of Energy
EPA	Environmental Protection Agency
HDPE	High-Density Polyethylene
ITS	Interceptor Trench System
ITPH	Interceptor Trench Pump House
mg/l	milligrams per liter
pCi/l	Picocuries per liter
PVC	Polyvinyl Chloride
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services

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1.0 INTRODUCTION

This report documents the completion of the Solar Ponds Plume Project at the Rocky Flats Environmental Technology Site (RFETS) and will be finalized when as-built drawings are available. This project was conducted in accordance with the Solar Ponds Plume Decision Document (RMRS 1999).

As a result of past waste storage practices at the Solar Ponds, nitrate and uranium are present in groundwater in excess of the Action Level Framework Tier II level groundwater concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE 1996). The contaminated groundwater has migrated away from the source area towards North Walnut Creek.

As defined in the Decision Document (RMRS 1999), the objectives of this project were to:

- Protect North Walnut Creek by reducing the mass loading of nitrate to surface water and ensure that surface water standards are met in the Creek.
- Design and install a passive system to intercept and treat the contaminated groundwater of the Solar Ponds Plume to remove nitrate.
- Design and construct the reactive barrier system in a manner which minimizes the generation of low-level mixed waste and/or hazardous waste and protects the habitat of Preble's Meadow Jumping Mouse, which was added to the Threatened Species List on May 18, 1998.
- Design the reactive barrier system to allow easy access for operation and maintenance and for reactive media replacement or removal.
- Evaluate the effectiveness of reactive barrier system in removing nitrate.
- Evaluate long-term effectiveness of the treatment system.

2.0 PROJECT BACKGROUND

Five Solar Evaporation Ponds, located in the northeast corner of the Protected Area, were used to store and evaporate radioactive and hazardous liquid wastes. These ponds were drained and sludge removal was completed in 1995. Removal of the sludges eliminated the nitrate and uranium source for the Solar Ponds Plume (RMRS 1999).

To dewater the hillside, six interceptor trenches were installed in 1971. The original six trenches were abandoned in place and the current Interceptor Trench System (ITS) was installed in 1981. The ITS is generally keyed into bedrock and effectively collects much of the water; however some groundwater underflows the collection system, and eventually discharges to North Walnut Creek. About 2.4 million gallons of water were collected from the ITS each year, pumped to the modular storage tanks for storage, and then pumped to Building 374 for evaporation (RMRS 1999).

The Solar Ponds are located on the flat surface at the northern edge of the pediment. A north facing hillside slopes downward to North Walnut Creek. In the Solar Ponds area, the Rocky Flats Alluvium is up to 23 feet thick. The area of the ITS is primarily covered with a thin layer of colluvium. Bedrock is

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composed of weathered claystone of the Arapahoe and Laramie Formations. In addition, the Arapahoe No. 1 Sandstone subcrops under the alluvium in the Solar Ponds area. The sandstone does not extend into the drainage, but tends to direct groundwater flow into the collection system (RMRS 1999).

The existing ITS system and the bedrock surface features primarily control groundwater flow. Areas of unsaturated colluvium and shallow bedrock are common. Groundwater flow in the colluvium follows small, north-south trending paleochannels cut into the underlying bedrock claystone.

The Solar Ponds Plume consists of nitrate and uranium contaminated groundwater that extends primarily northward from the source area towards the North Walnut Creek. The highest concentrations of uranium in groundwater are found adjacent to the Solar Ponds, while the higher concentrations of nitrates are found at a greater distance from the ponds. The nitrate plume has a greater areal extent than the uranium plume. The data suggest that while there is uranium in groundwater near North Walnut Creek it is naturally occurring and not part of the uranium plume. The ITS system does drain a portion of the uranium plume and the water from the ITS does contain uranium from that portion of the plume. The average concentration observed recently at the Interceptor Trench Pump House (ITPH) is 220 mg/l nitrate, and 61 pCi/l uranium.

3.0 SYSTEM INSTALLATION

A groundwater collection and treatment system was installed to passively capture and treat the contaminated groundwater. System installation began in June 1999 and was completed on September 22, 1999. The groundwater collection system extends approximately 1,100 feet in an east-west direction (Figure 1). Construction was restricted to the disturbed area around the North Perimeter Road to reduce impacts to Preble's Mouse habitat. Revegetation and regrading was completed in October 1999.

To install the collection system, an excavation was dug at a variable depth of approximately 20 to 30 feet below ground surface and approximately 10 feet into claystone. An impermeable barrier was installed that consists of 80-mil high-density polyethylene (HDPE) panels fitted with an interlocking strip on each side. A hydrophilic cord was threaded through the entire length of the interlock. This cord swells when wet, further sealing the panels together. These panels are 15 feet wide and of a variable height depending on the installation depth. The collection trench cuts across the existing ITS system and intercepts the collected ITS water system upstream of the barrier. The existing ITS is now used to enhance recovery by the collection trench.

The bottom of the collection trench was filled with bentonite pellets to limit bypass or leakage. On the upgradient side of the barrier, approximately one foot of sand was placed over the bentonite. A four-inch perforated HDPE groundwater collection line was bedded into the sand, and piped to the reactor vessel. Sand was then placed around and several feet above the horizontal collection line. The trench was then backfilled. Four piezometers were installed in the collection trench for monitoring water levels within the collection system (Figure 1).

A 46-feet long by 21-feet wide (exterior dimensions) concrete treatment vessel was installed below grade to treat the contaminated groundwater. The location of the treatment vessel was determined by the Preble's Mouse habitat, and by the results of the geotechnical survey. Because of the Preble's Mouse

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habitat limitations, the treatment cell could not be placed within the stream drainage. Therefore, approximately 12 feet of hydraulic head is required in the collection trench before water enters the treatment cells.

The exterior treatment vessel walls are 2 feet thick and extend approximately 25 feet to the ground surface, for ease in locating the cells and replacing the media. The vessel is divided into two treatment cells by an 18-inch thick, 12-feet high, internal wall. Treatment media occupies the lower 10 feet of each cell. Geomembrane was placed over the media to prevent backfilled materials from settling into the treatment media. The vessel was backfilled with wood chips to reduce the weight over the treatment media, with a final soil cap placed to reduce precipitation infiltration. Small weep holes were installed just above the geomembrane in the north wall of the treatment vessel. These small holes allow precipitation and runoff to drain out of the vessel without entering the treatment media.

The first cell is 31 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with a mixture of sawdust and leaf mold with 10% zero-valent iron by weight to induce denitrification and to remove the uranium by chemical reduction. The media was selected on the basis of bench scale tests conducted at the University of Waterloo. The second cell is 10 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with zero-valent iron to act as a final polisher. There is a one-foot thick layer of gravel at the bottom of both treatment cells. Wood chips at the top of the largest cell and a simple polyvinyl chloride (PVC) pipe dispersion gallery over the upgradient half of the cell spread out the contaminated groundwater over the treatment media. The two treatment cells can be run in series or in parallel. Figure 2 shows the details of the treatment vessel.

The uppermost (southernmost) trench of the ITS was designed to collect surface water from the Solar Ponds area. The trench was gravel filled to the ground surface. It is estimated that up to 700,000 gallons of water were collected and treated from this trench. Because the surface water is not contaminated, this trench was blocked to reduce surface water collection by the new system. A nominal 2-foot deep trench was excavated over the upper trench, 20 mil HDPE membrane was laid over the gravel, and the excavation was refilled with native soil mixed with the gravel removed from the trench.

4.0 DEVIATIONS FROM THE DECISION DOCUMENT

Two changes were made to the design as presented in the Solar Ponds Plume Decision Document (RMRS 1999). These changes were discussed with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE).

A well cluster was installed north of the collection system to provide additional data and for performance monitoring purposes. Three wells were planned with the intent to monitor the colluvium, upper weathered bedrock, and lower weathered bedrock. When the first well was installed, it was noted that only 7 feet of weathered bedrock is present at this location. The decision was then made to install one well to monitor the entire weathered bedrock interval at this location as wells in the upper and lower weathered bedrock were expected to give similar results. Therefore, only two wells were installed; one to monitor the colluvium (70099) and one to monitor the weathered bedrock (70299).

To expedite installation of the collection trench, a working bench was cut approximately 10 feet deep to reduce the depth of the excavation required for installation of the collection system. Barrier panels were originally planned to extend from the bottom of the collection trench to about 2 feet below ground surface as shown in the Decision Document. However, as groundwater flow is generally in the colluvium immediately above the bedrock surface and in the weathered bedrock, the panels were shortened to approximately the depth of the working bench. In addition, the pre-existing ITS now funnels the groundwater into the new collection system along pre-existing laterals. Based on the depth to water and the depth of the existing ITS piping, downgradient flow is effectively blocked, and the groundwater plume is effectively captured. Modifications are as follows.

- At the western end of the system, (the western 350 feet) groundwater within the collection trench will be at the highest elevation. Panels were installed at an elevation of 5893, approximately 8 feet above the projected groundwater table and between 5 and 10 feet below ground surface.
- For the middle 350 feet of the collection system, the tops of panels are approximately 10 feet below ground surface.
- At the eastern end of the system, (the eastern 250 feet) the top of panels are approximately 5 below ground surface due to the location of ITS collection pipes about 10 feet below ground surface.

Two minor design modifications were necessitated by utilities that were not located as shown on the Site drawings. The first minor change was required by the ITS line entering the ITPH at a lower elevation than anticipated. When the discharge system was initially excavated, it was noted that the discharge area would be 3 feet higher than the ITS line. The discharge area was then moved about 20 feet further east to the lowest point along the road. Water from the system now drains into the discharge gallery.

The second minor design change was caused by the location of the 60-inch reinforced concrete storm drain that was approximately 30 feet east of where it is shown on Site drawings. The storm drain could not be relocated, and it interfered with placement of the last panel. The top of the storm drain is above the level of groundwater in the trench and above the ITS lines. Placing the panel on top of the storm drain would not result in capture or storage of groundwater. Placing the panel underneath the storm drain could weaken it, and would open a preferential pathway for groundwater to leave the system. Therefore, the last panel was not placed. Instead, 10 supersacks of bentonite, at approximately 3,500 pounds each, were used to seal off the western end of the collection trench including the area around the storm drain. This is sufficient to keep water in the collection trench and to block discharge of water around the storm drain.

Also of note, a large tear occurred in the panels immediately adjacent to the treatment cell. The tear was patched using hot welding techniques. Two bags of bentonite were placed in front of the repaired area to further prevent leakage.

5.0 REFERENCES

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO, July.

RMRS, 1999, *Final Solar Ponds Plume Decision Document*, RF/RMRS-98-286.UN.

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SOLAR PONDS PLUME PROJECT

COMPLETION REPORT
FISCAL YEAR 1999

Rocky Flats Environmental Technology Site
September 30, 1999

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FIGURES

ACRONYM LIST

DOE	Department of Energy
EPA	Environmental Protection Agency
HDPE	High-Density Polyethylene
ID	Inside Diameter
ITS	Interceptor Trench System
ITPH	Interceptor Trench Pump House
mg/l	milligrams per liter
pCi/l	Picocuries per liter
PVC	Polyvinyl Chloride
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services

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1.0 INTRODUCTION

This report documents the completion of the Solar Ponds Plume Project at the Rocky Flats Environmental Technology Site (RFETS). This project was conducted in accordance with the Solar Ponds Plume Decision Document (RMRS 1999).

As a result of past waste storage practices at the Solar Ponds, nitrate and uranium are present in groundwater in excess of the Action Level Framework Tier II level groundwater concentrations defined in the Rocky Flats Cleanup Agreement (RFCA) (DOE 1996). The contaminated groundwater has migrated away from the source area towards North Walnut Creek.

As defined in the Decision Document (RMRS 1999), the objectives of this project were to:

- Protect North Walnut Creek by reducing the mass loading of nitrate to surface water and ensure that surface water standards are met in the Creek.
- Design and install a passive system to intercept and treat the contaminated groundwater of the Solar Ponds Plume to remove nitrate.
- Design and construct the reactive barrier system in a manner which minimizes the generation of low-level mixed waste and/or hazardous waste and protects the habitat of Preble's Meadow Jumping Mouse, which was added to the Threatened Species List on May 18, 1998.
- Design the reactive barrier system to allow easy access for operation and maintenance and for reactive media replacement or removal.
- Evaluate the effectiveness of reactive barrier system in removing nitrate.
- Evaluate long-term effectiveness of the treatment system.

2.0 PROJECT BACKGROUND

Five Solar Evaporation Ponds, located in the northeast corner of the Protected Area, were used to store and evaporate radioactive and hazardous liquid wastes. These ponds were drained and sludge removal was completed in 1995. Removal of the sludges eliminated the nitrate and uranium source for the Solar Ponds Plume. The ~~long-term remedial action for the source area is expected to be capping, which will further retard movement of the uranium.~~

To dewater the hillside, six interceptor trenches were installed in 1971. The original six trenches were abandoned in place and the current Interceptor Trench System (ITS) was installed in 1981. The ITS is generally keyed into bedrock and effectively collects ~~most~~ much of the water; however, up to one third of the groundwater underflows the collection system, and eventually discharges to North Walnut Creek. About 2.4 million gallons of water were collected from the ITS each year, pumped to the modular storage tanks for storage, and then pumped to Building 374 for evaporation.

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The Solar Ponds are located on the flat surface at the northern edge of the pediment. A north facing hillside slopes downward to North Walnut Creek. In the Solar Ponds area, the Rocky Flats Alluvium is up to 23 feet thick. The area of the ITS is primarily covered with a thin layer of colluvium. Bedrock is composed of weathered claystone of the Arapahoe and Laramie Formations. In addition, the Arapahoe No. 1 Sandstone subcrops under the alluvium in the Solar Ponds area. The sandstone does not extend into the drainage, but tends to direct groundwater flow into the collection system.

The existing ITS system and the bedrock surface features primarily control groundwater flow. Areas of unsaturated colluvium and shallow bedrock are common. Groundwater flow in the colluvium follows small, north-south trending paleochannels cut into the underlying bedrock claystone.

The Solar Ponds Plume consists of nitrate and uranium contaminated groundwater that extends primarily northward from the source area towards the North Walnut Creek. The highest concentrations of uranium are found adjacent to the Solar Ponds, while the higher concentrations of nitrates are found at a greater distance from the ponds. The nitrate plume has a greater areal extent than the uranium plume. The data suggest that the uranium in groundwater near North Walnut Creek is naturally occurring and not part of the uranium plume. The ITS system does drain a portion of the uranium plume and the water from the ITS does contain uranium from that portion of the plume. The average concentration observed recently at the Interceptor Trench Pump House (ITPH) is 220 mg/l nitrate, and 61 pCi/l uranium.

3.0 SYSTEM INSTALLATION

A groundwater collection and treatment system was installed to passively capture and treat the contaminated groundwater. System installation began in June 1999 and was completed on September 22, 1999. The groundwater collection system extends approximately 1,100 feet in an east-west direction (Figure 1) along the north east perimeter road. Construction was restricted to the disturbed area around the North Access Road to reduce impacts to Preble's Mouse habitat.

To install the collection system, an excavation was dug at a variable depth of approximately 20 to30 feet below ground surface and approximately 10 feet into claystone. An impermeable barrier was installed that consists of 80-mil high-density polyethylene (HDPE) panels fitted with an interlocking strip on each side. A hydrophilic cord was threaded through the entire length of the interlock. This cord swells when wet, further sealing the panels together. These panels are 15 feet wide and of a variable height depending on the installation depth. The collection trench cuts across the existing ITS system and intercepts the collected ITS water system upstream of the barrier. The existing ITS is now used to enhance recovery by the collection trench.

The bottom of the collection trench was filled with bentonite pellets to limit bypass or leakage. On the upgradient side of the barrier, approximately one foot of sand was placed over the bentonite. A four-inch perforated HDPE groundwater collection line was bedded into the sand, and piped to the reactor vessel. Sand was then placed around and several feet above the horizontal collection line. The trench was then backfilled. Four piezometers were installed in the collection trench for monitoring water levels within the collection system (Figure 1).

A 46-foot long by 21-foot wide (exterior dimensions) concrete treatment vessel was installed below grade to treat the contaminated groundwater. The location of the treatment vessel was determined by the Preble's Mouse habitat, and by the results of the geotechnical survey. Because of the Preble's Mouse habitat limitations, the treatment cell could not be placed within the stream drainage. Therefore, a hydraulic head of approximately 15 feet is required in the collection trench before water enters the treatment cells. ? 12 ft?

The exterior treatment vessel walls are 2 feet thick and extend approximately 25 feet to the ground surface, for ease in locating the cells and replacing the media. The vessel is divided into two treatment cells by an 18-inch thick, 12-foot high, internal wall. Treatment media occupies the lower 10 feet of each cell. Geotextile was placed over the media to prevent backfilled materials from settling into the treatment media. The vessel was backfilled with wood chips to reduce the weight over the treatment media, with a final soil cap placed to reduce precipitation infiltration. Weep holes were installed in the north wall of the vessel to allow precipitation to exit the system. ? what does this mean

The first cell is 31 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with a mixture of sawdust, zero-valent iron and leaf mold to induce denitrification and to remove the uranium by chemical reduction. The media was selected on the basis of bench scale tests conducted at the University of Waterloo. The second cell is 10 feet 6 inches long by 17 feet wide (interior dimensions) and is filled with zero-valent iron to act as a final polisher. There is a one-foot thick layer of gravel at the bottom of both treatment cells. Wood chips at the top of the largest cell and a simple polyvinyl chloride (PVC) pipe dispersion gallery over the upgradient half of the cell spread out the contaminated groundwater over the treatment media. The two treatment cells can be run in series or in parallel. Figure 2 shows the details of the treatment vessel.

The uppermost (southernmost) trench of the ITS was designed to collect surface water from the Solar Ponds area for eventual treatment at Building 374. The trench was gravel filled to the ground surface. It is estimated that up to 700,000 gallons of water were collected and treated from this trench. Because the surface water is not contaminated, this trench was blocked to reduce surface water collection by the new system. A nominal 2-foot deep trench was excavated over the upper trench, 20 mil HDPE membrane was laid over the gravel, and the excavation was refilled with native soil mixed with the gravel removed from the trench.

4.0 DEVIATIONS FROM THE DECISION DOCUMENT

Two changes were made to the design as presented in the Solar Ponds Plume Decision Document (RMRS 1999). These changes were discussed with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE).

A well cluster was installed north of the collection system to provide additional data and for performance monitoring purposes. Three wells were planned with the intent to monitor the colluvium, upper weathered bedrock, and lower weathered bedrock. When the first well was installed, it was noted that only 7 feet of weathered bedrock is present at this location. The decision was then made to install one well to monitor the entire weathered bedrock interval at this location as wells in the upper and lower weathered bedrock were expected to give similar results. Therefore, two wells were installed; one to monitor the colluvium (70099) and one to monitor the weathered bedrock (70299).

To expedite installation of the collection trench, a working bench was cut approximately 10 feet deep to reduce the depth of the excavation required for installation of the collection system. Barrier panels were originally planned to extend from the bottom of the collection trench to about 2 feet below ground surface as shown in the Decision Document. However, as groundwater flow is generally in the colluvium immediately above the bedrock surface and in the weathered bedrock, the panels were shortened to approximately the depth of the working bench. In addition, the current Interceptor Trench System (ITS) ~~system~~ already captures 85% or more of the groundwater in the Solar Ponds Plume. This water now enters the new collection ~~system~~ along pre-existing laterals. Based on the depth to water and the depth of the existing ITS piping, downgradient flow is effectively blocked, and the groundwater plume is effectively captured. Modifications are as follows.

- At the western end of the system, (the western 350 feet) groundwater within the collection trench will be at the highest elevation. Panels were installed at an elevation of 5893, approximately 8 feet above the projected groundwater table and between 5 and 10 feet below ground surface.
- For the middle 350 feet of the collection system, the tops of panels are approximately 10 feet below ground surface.
- At the eastern end of the system, (the eastern 250 feet) the top of panels are approximately 5 below ground surface due to the expected occurrence of ITS collection pipes at depths about 10 feet below ground surface.

Two additional design modifications were necessitated by utilities that were not located as shown on the Site drawings. The first minor change was required by the ITS line entering the ITPH at a lower elevation than anticipated. When the discharge system was initially excavated, it was noted that the discharge area would be 3 feet higher than the ITS line. The discharge area was then moved about 20 feet further east to the lowest point along the road. Water from the system will now drain into the discharge gallery.

The second change was caused by the location of the 60-inch reinforced concrete storm drain that was approximately 30 feet east of where it is shown on Site drawings. The culvert interfered with placement of the last panel as the culvert could not be moved or relocated. The top of the culvert is above the level of groundwater in the trench and above the ITS lines. Placing the panel on top of the culvert would not result in capture or storage of groundwater. Placing the panel underneath the culvert could weaken the culvert, and would open a preferential pathway for groundwater to leave the system. Therefore, the last panel was not placed. Instead, 10 supersacks of bentonite, at approximately 3,500 pounds each, were used to seal off the western end of the collection trench including the area around the storm drain. This is sufficient to hold water in the collection trench, and to block discharge of water from around the culvert.

Also of note, a large tear occurred in the panels immediately adjacent to the treatment cell. The tear was patched using hot welding techniques. Two bags of bentonite were placed in front of the repaired area to further prohibit leakage.

5.0 REFERENCES

DOE, 1992, *Final Historical Release Report for the Rocky Flats Plant*, 21100-TR-12501.01, Rocky Flats Plant, Golden, CO, July.

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO, July.

RMRS, 1999, *Final Solar Ponds Plume Decision Document*, RF/RMRS-98-286.UN.

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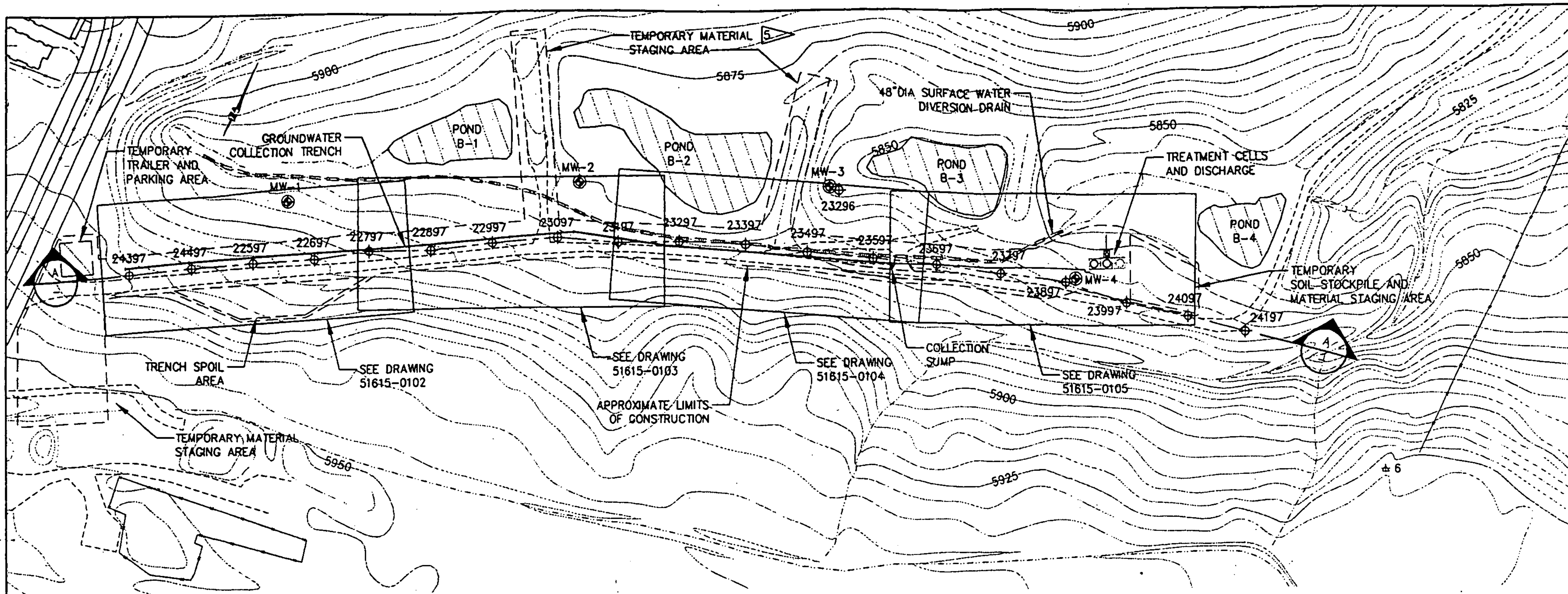
PART	QUAN.	DESCRIPTION	MATERIAL



SITE PLAN 1 2 3 4

100' 0 100'

SCALE: 1"=100'-0"

LEGEND

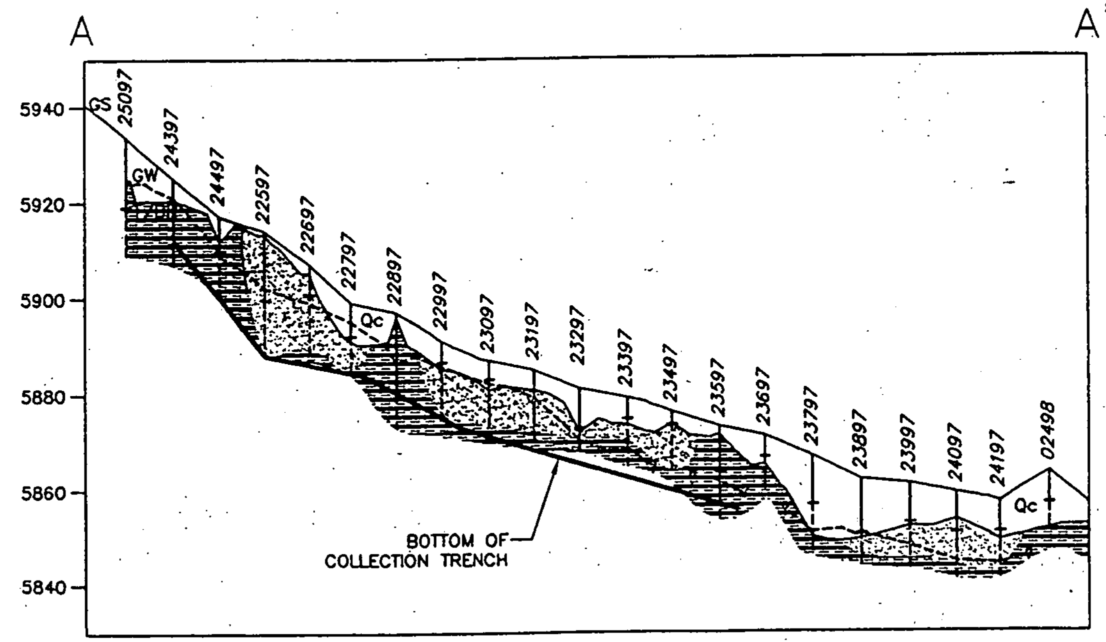
- EXISTING PIEZOMETER LOCATION
- NEW MONITORING WELL
- 6 BENCHMARK
- EXISTING SURFACE WATER DRAINAGE
- EXISTING GRAVEL ROAD
- EXISTING IMPROVED ROAD
- EXISTING FENCE
- EXISTING TOPOGRAPHIC CONTOUR (feet above mean sea level) CONTOUR INTERVAL = 5ft
- GEOLOGIC PROFILE LOCATION
- EXISTING POND

COORDINATE LIST 6
NEW MONITORING WELLS:

	NORTHING	EASTING	ELEVATION	DESCRIPTION
MW-1	750305.03	2086855.71		
MW-2	750524.82	2087254.56		
MW-3	750681.80	2087608.77		
MW-4	750721.94	2088016.62		

BENCHMARKS:

6	750660.2	2088575.7	5930.8	#4 BAR-FB983 + BM12/50.
202	749491.2	2086607.1	---	UNKNOWN
273	750679.4	2086580.7	5959.0	#4BAR + CAP-TRIG ELEV



GEOLOGIC PROFILE (FACING NORTHWEST)

PROFILE LEGEND

- GS GROUND SURFACE
- GW GROUND WATER SURFACE
- T/BR TOP OF BEDROCK
- QrF ROCKY FLATS ALLUVIUM
- Qc COLLUVIUM
- CLAYSTONE
- SANDSTONE, UNDIFFERENTIATED ARAPAHOE/LARAMIE
- ARAPAHOE NO. 1 SANDSTONE
- 23897 MONITORING WELL OR PIEZOMETER
- SCREENED INTERVAL

HORIZONTAL GRAPHIC SCALE
0 100 200
(IN FEET)
1 inch = 200 ft.
VERTICAL SCALE
1 inch = 20 ft.

NOTES:

1. DATA SOURCE FOR BASEMAPS IS ROCKY MOUNTAIN REMEDIATION SERVICES, L.L.C. BUILDINGS, FENCES, HYDROGRAPHY, ROADS AND OTHER STRUCTURES FROM 1994 AERIAL FLY-OVER DATE CAPTURED BY EG&G RSL, LAS VEGAS. DIGITIZED FROM THE ORTHOPHOTOGRAPHS 1/95. TOPOGRAPHIC CONTOURS WERE DERIVED FROM DIGITAL ELEVATION MODEL (DEM) DATA BY MORRISON KNUDSON (MK) USING ESRI "ARC TIN" AND "LATTICE" TO PROCESS THE DEM DATA TO CREATE 5-foot CONTOURS. THE DEM DATA WAS CAPTURED BY THE REMOTE SENSING LAB, LAS VEGAS, NV, 1994 AERIAL FLYOVER AT ~ 10 METER RESOLUTION. THE DEM POST-PROCESSING PERFORMED BY MK, WINTER 1997.
2. BURIED 480 VOLT POWER OR OTHER UTILITIES MAY BE PRESENT IN THE VICINITY.
3. MAINTAIN SURFACE WATER DIVERSION DITCHES UP HILL OF LIMITS OF CONSTRUCTION.
4. MAINTAIN SILT FENCE FOR EROSION CONTROL DOWN HILL OF LIMITS OF CONSTRUCTION.
5. MAINTAIN ACCESS THROUGH STAGING AREAS AND RESTORE TO ORIGINAL CONDITION.
6. LOCATIONS SHOWN IN STATE PLANE COORDINATES.

Figure 1

East Trenches Plume System Location Map

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
P. O. Box 464
Golden, Colorado 80402-0464

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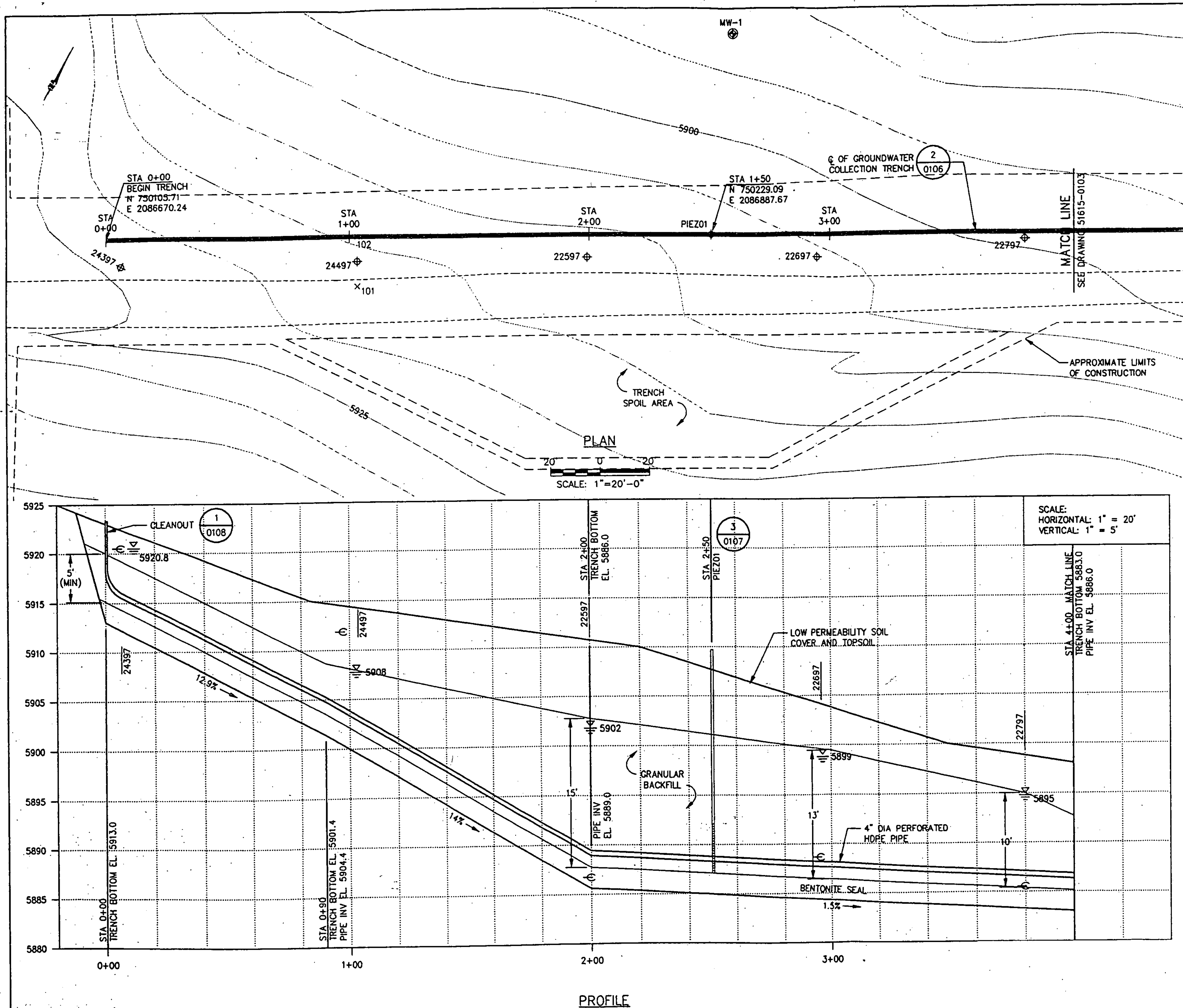

PART	QUAN.	DESCRIPTION	MATERIAL

LEGEND

- NEW MONITORING WELL
- EXISTING PIEZOMETER
- NEW TRENCH PIEZOMETER
- × TEMPORARY DESIGN REFERENCE POINTS
- EXISTING SURFACE WATER DRAINAGE
- EXISTING GRAVEL ROAD
- EXISTING IMPROVED ROAD
- EXISTING FENCE
- 5900 EXISTING TOPOGRAPHIC CONTOUR (feet above mean sea level) CONTOUR INTERVAL = 5ft
- TOP OF CLAYSTONE BEDROCK
- WATER TABLE ELEVATION (APRIL TO JUNE 1998)

SURVEY DATA 1 2

LOCATION	NORTHING	EASTING	GROUND SURFACE ELEVATION	DESCRIPTION
101	750139.3	2086769.9	5919.0	TEMPORARY DESIGN SURVEY POINTS
102	750156.7	2086760.1	5914.3	TEMPORARY DESIGN SURVEY POINTS

NOTE:

1. LOCATIONS SHOWN IN STATE PLANE COORDINATES.
2. EXISTING WOODEN STAKES USED FOR DESIGN; ESTABLISH SURVEY CONTROL DURING CONSTRUCTION FROM SITE BENCHMARKS.

Figure 2

East Trenches Plume Collection Trench Details

RMRS

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Rocky Flats Environmental Technology Site
P. O. Box 464
Golden, Colorado 80402-0464

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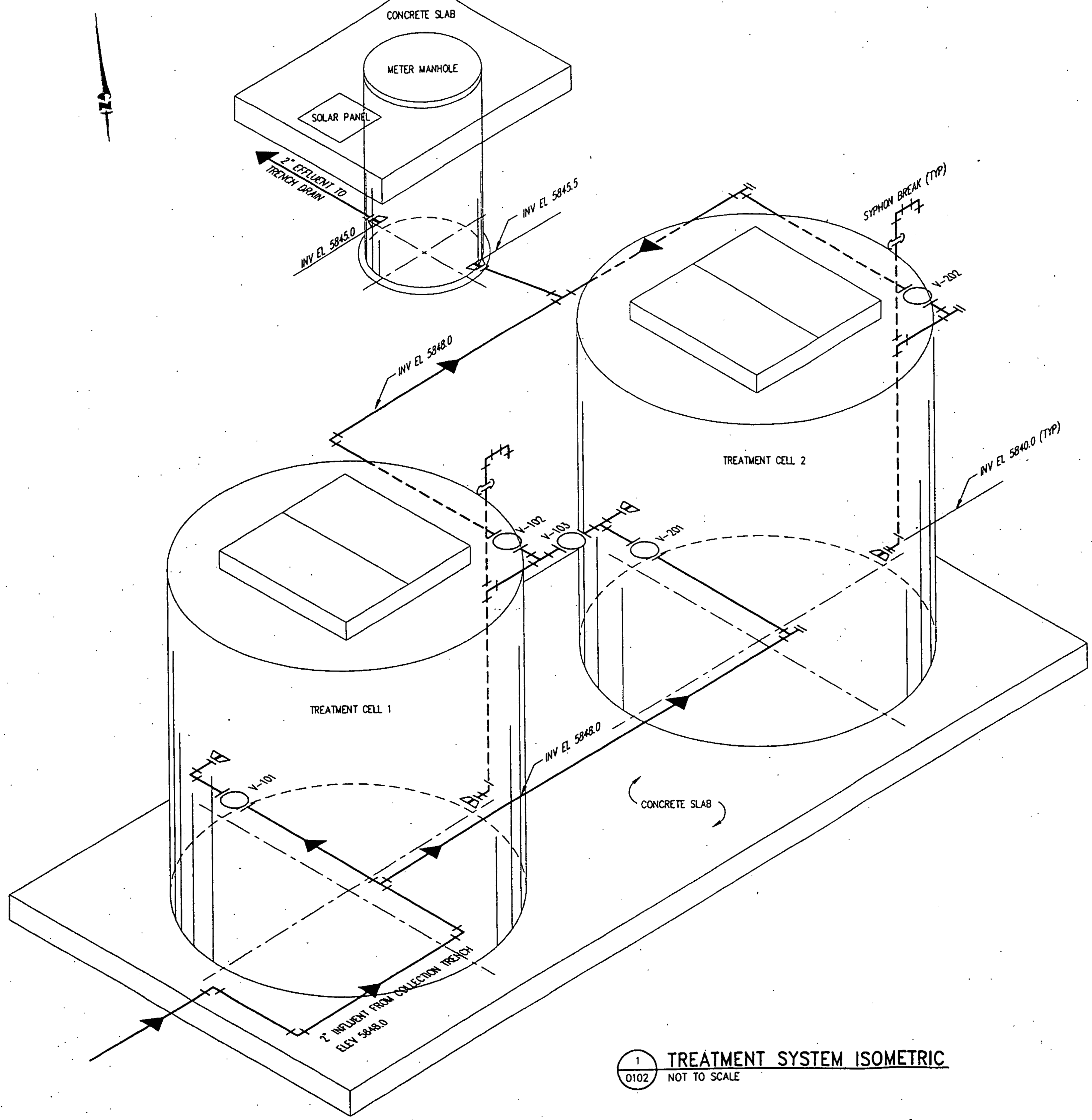
PART	QUAN.	DESCRIPTION	MATERIAL



1 / 0102 TREATMENT SYSTEM ISOMETRIC
NOT TO SCALE

LEGEND

- PIPE AND DIRECTION OF FLOW
- BALL VALVE
- STRAIGHT TEE
- 90° ELBOW
- UNION (REMOVABLE)
- CAP (FOR FUTURE PIPING CONNECTION)
- FLANGED, GASKETED, AND BOLTED CONNECTION

Figure 3

East Trenches Plume Treatment System Isometric

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
P. O. Box 464
Golden, Colorado 80402-0464

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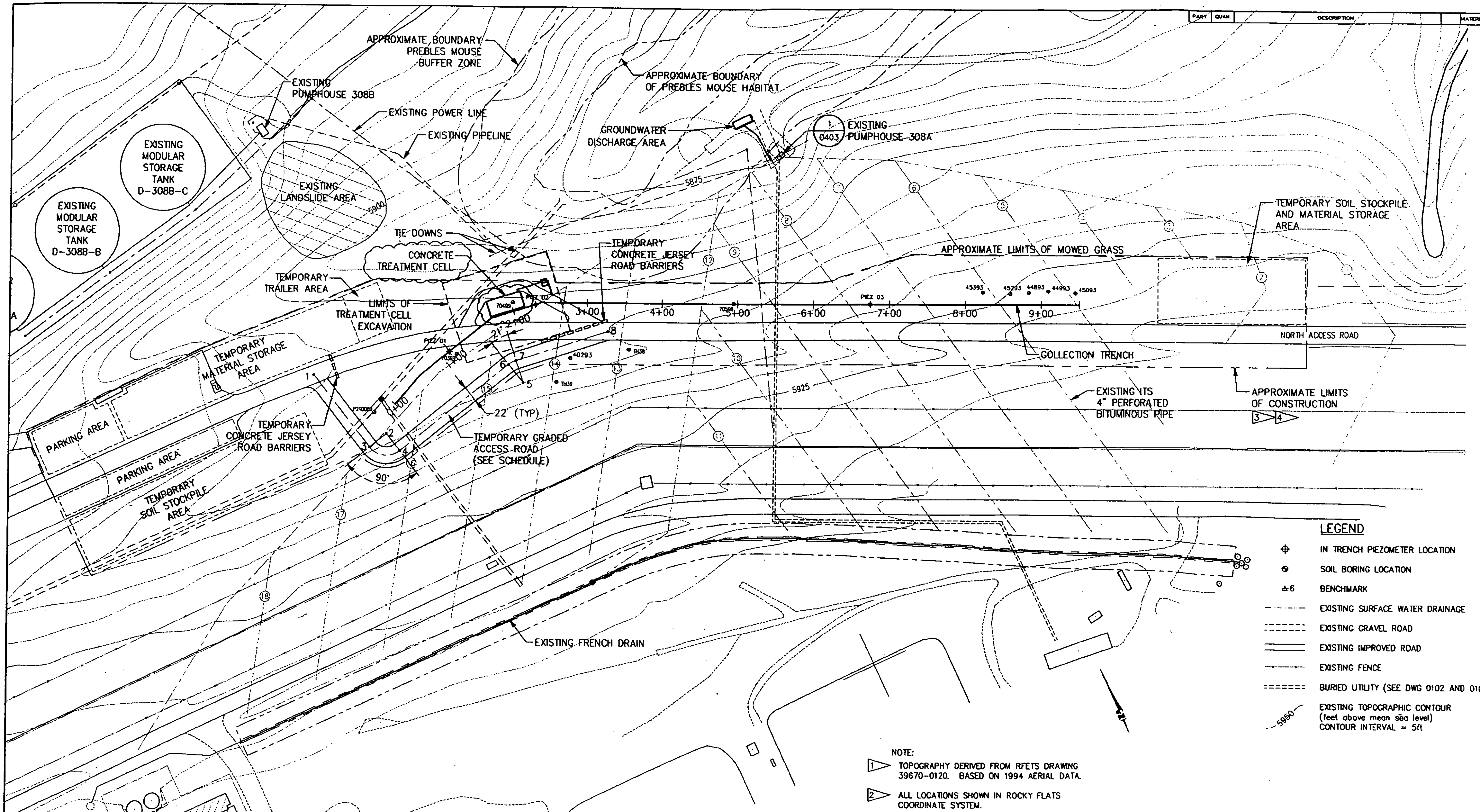


NOTE:

1. TOPOGRAPHY DERIVED FROM RFETS DRAWING 39670-0120. BASED ON 1994 AERIAL DATA.
2. ALL LOCATIONS SHOWN IN ROCKY FLATS COORDINATE SYSTEM.
3. MAINTAIN SURFACE WATER DIVERSION UPHILL OF LIMITS OF CONSTRUCTION.
4. MAINTAIN SILT FENCE FOR EROSION CONTROL DOWNHILL OF LIMITS OF CONSTRUCTION.

COORDINATES FOR 1999 GEOTECHNICAL BORINGS 2

Northing	Easting	Ground Elevation	Description
38601.93	21670.66	5899.48	DRILL HOLE (No. 1) 70399
38632.20	21764.99	5900.83	DRILL HOLE (No. 2) 70499
38507.04	22030.69	5908.44	DRILL HOLE (No. 3) 70599

SITE PLAN

60' 0 60'

SCALE: 1"=60'

LOCATION INFORMATION FOR TEMPORARY ACCESS ROAD

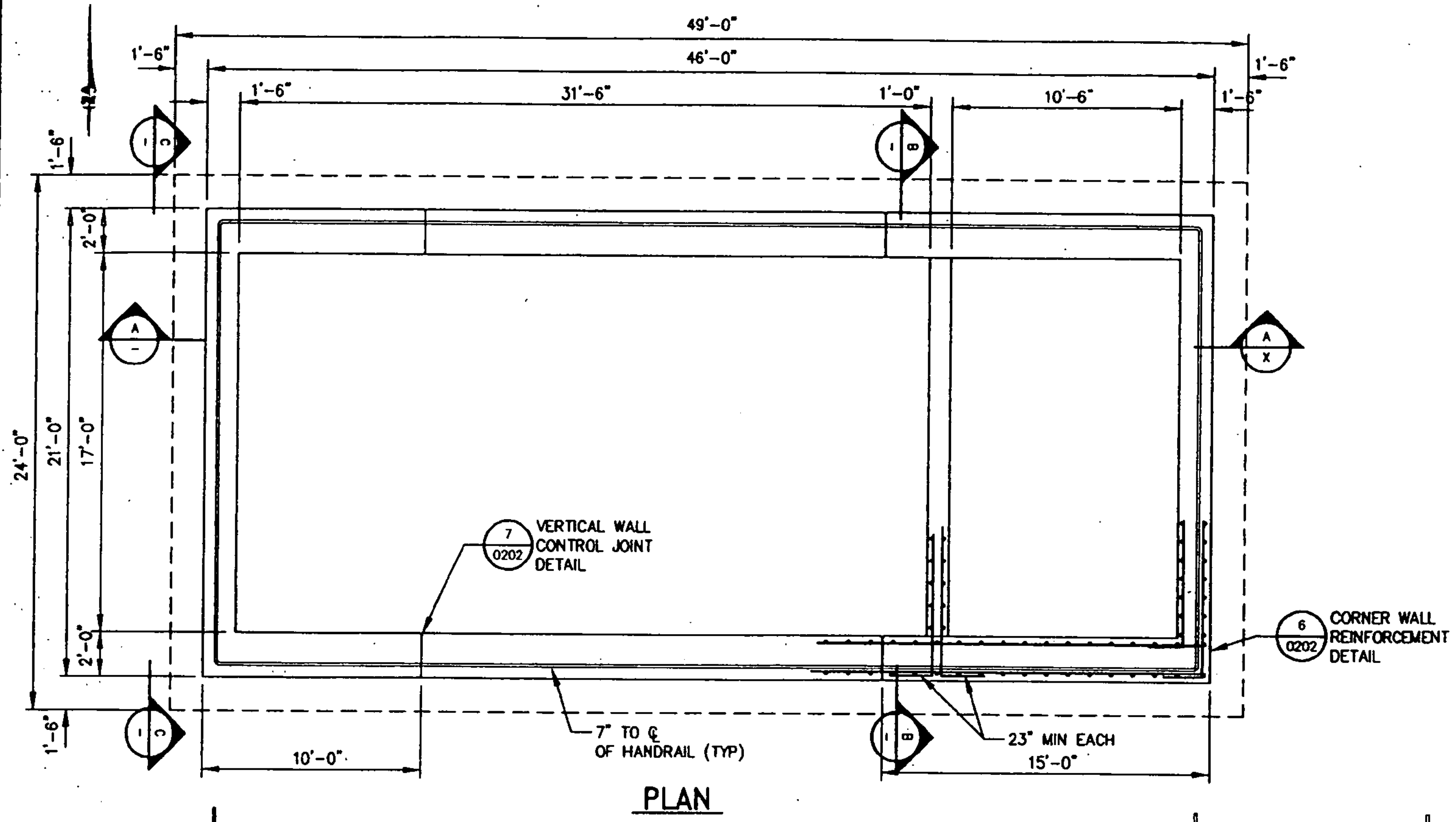
POINT	NORTHING	EASTING
1	38658.01	21485.73
2	38547.20	21541.87
3	38540.50	21513.66
4	38518.99	21548.58
5	38531.97	21732.95
6	38561.16	21726.02
7	38561.71	21736.91
8	38544.83	21863.77

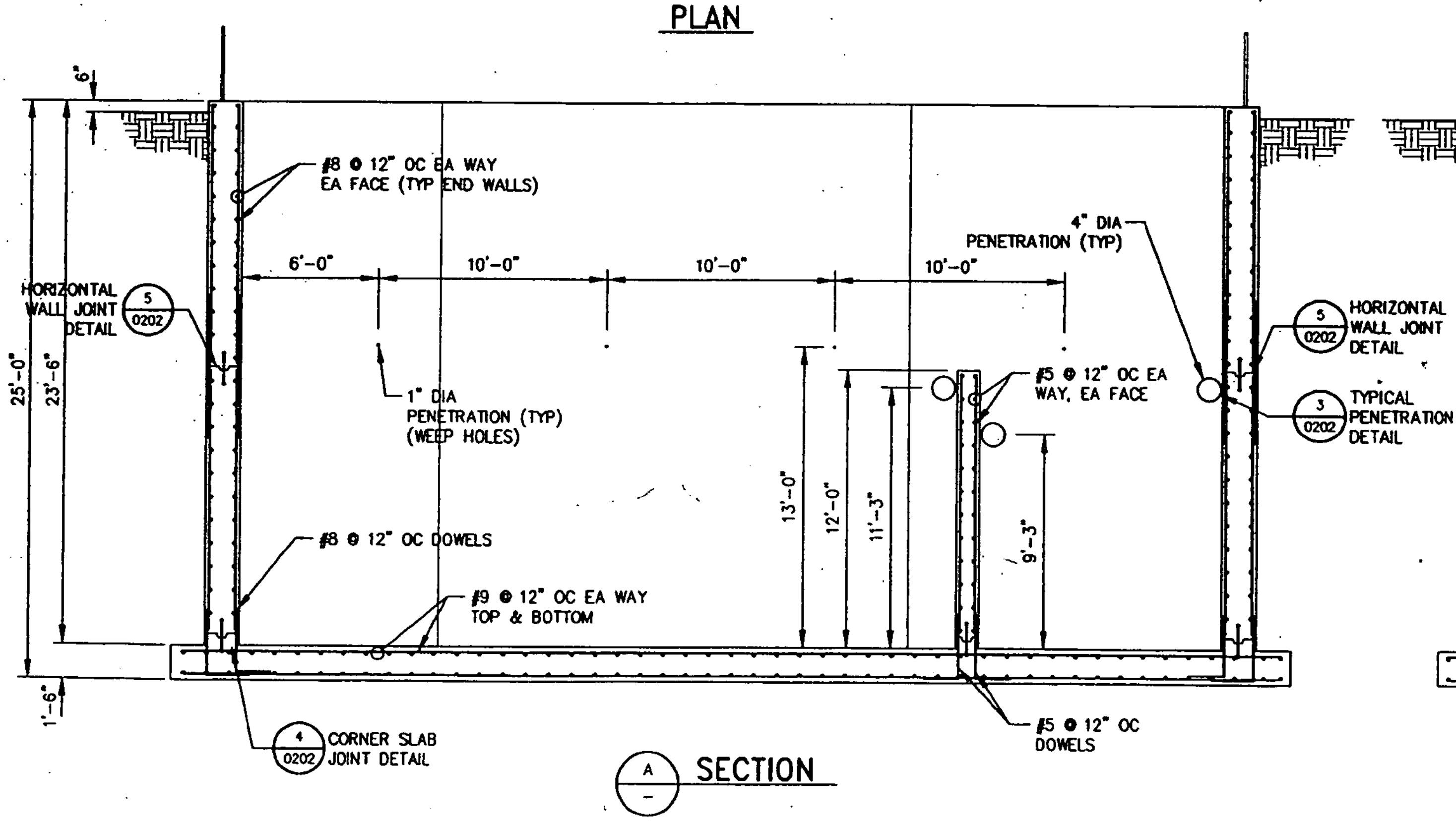
Figure 1

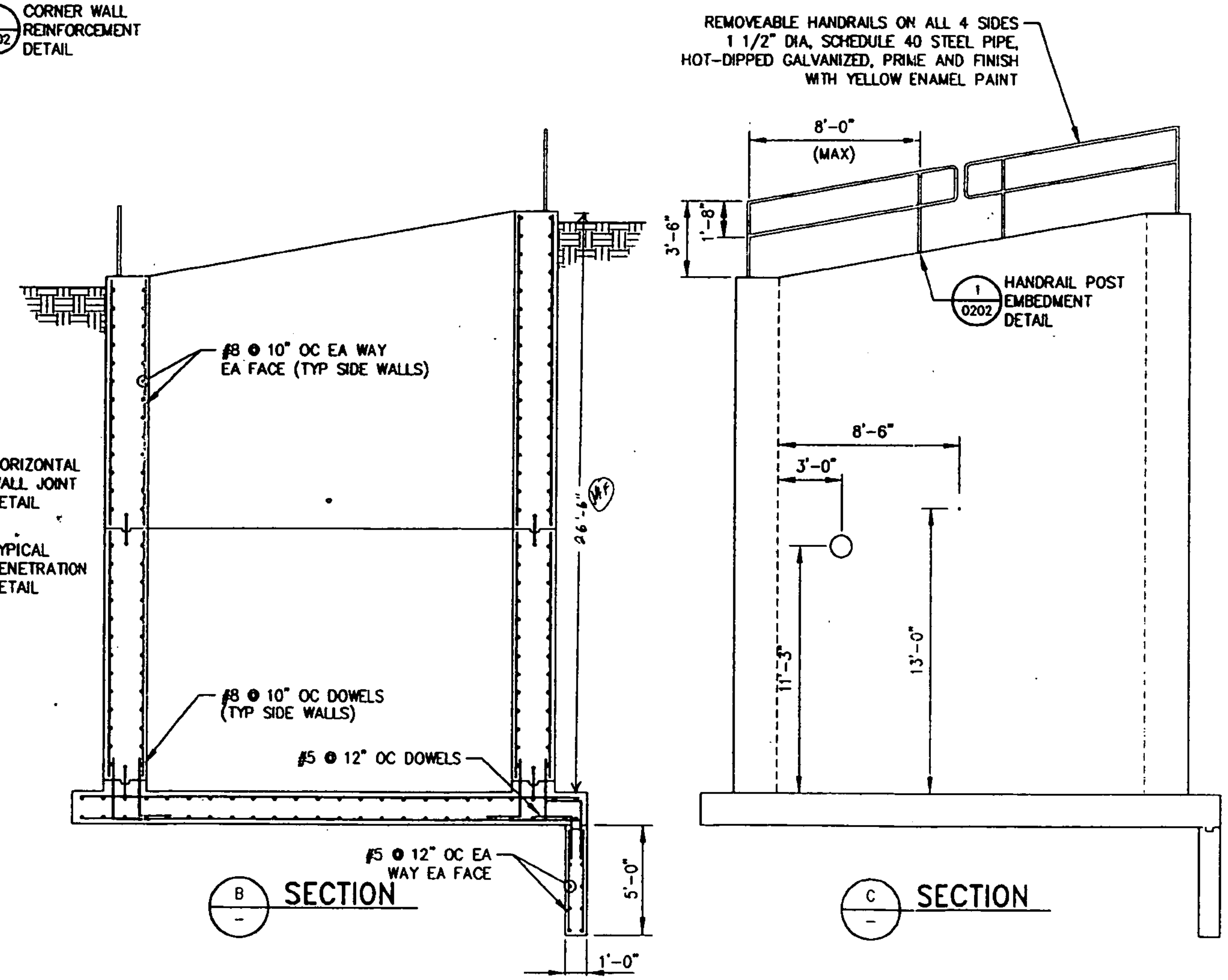
Groundwater System Locations

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80403-8200

17







NOTES:

1. CONCRETE MINIMUM STRENGTH SHALL BE 4000 PSI AT 28 DAYS.
2. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM A 615 GRADE 60. DOWEL BARS SHALL BE ~~PLAIN STEEL~~ Deformed BARS CONFORMING TO ASTM A 615 GRADE 60. MF
3. ALL CONCRETE AND REINFORCING STEEL SHALL BE FURNISHED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE ACI STANDARD BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE ACI 318-95.
4. ALL REINFORCING STEEL SHALL BE DETAILED IN ACCORDANCE WITH THE MOST RECENT VERSION OF ACI 315 "DETAILS AND DETAILING OF CONCRETE REINFORCEMENT".
5. PRIOR TO PLACING CONCRETE, ALL REINFORCING STEEL, DOWELS, WATERSTOPS, AND SLEEVES FOR PENETRATIONS, SHALL BE WELL SECURED IN POSITION AND APPROVED BY THE CONTRACTOR.
6. LOCATION OF ALL CONSTRUCTION JOINTS OR OTHER TYPES OF JOINTS OTHER THAN THOSE SPECIFIED, AND DETAILS OF ALL SLEEVES, OPENINGS, OR OTHER ATTACHMENTS NOT SHOWN ON THE DRAWINGS SHALL BE APPROVED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
7. PLACE VERTICAL CONTROL JOINTS IN LONG WALLS WHERE INDICATED OR WHERE APPROVED BY CONTRACTOR, BUT NOT MORE THAN 25' APART AND WITHIN 10' TO 15' OF CORNERS. DO NOT PLACE IN LOCATIONS WHERE DEVELOPEMENT LENGTH OF DOWELS WILL BE LESS THAN REQUIRED.
8. EXPOSED EDGES OF CONCRETE SHALL HAVE 3/4" CHAMFER.
9. REINFORCING STEEL FURNISHED AND INSTALLED SHALL BE FREE OF EXCESSIVE RUST, GREASE, MILL SCALE, OR ANY MATERIAL WHICH MAY AFFECT ITS BOND WITH CONCRETE.
10. SPLICES SHALL BE USED ONLY WHERE REQUIRED BASED ON AVAILABLE REINFORCEMENT LENGTHS. WHERE REQUIRED, SPLICES SHALL BE CLASS B SPLICE CONFORMING TO ACI 318-95. LAP #9 BARS 61" MINIMUM, LAP #8 BARS 49" MINIMUM AND LAP #5 BARS 16" MINIMUM, ENCLOSE WITH STIRRUPS OR TIES. TRANSVERSE SPACING OF #8 BARS AND #9 BARS SHALL BE NO GREATER THAN 6" AND SPACING OF #5 BARS SHALL BE NO GREATER THAN 3". STAGGER SPLICES A MINIMUM OF 24" LONGITUDINALLY.
11. MINIMUM CONCRETE COVER OVER REINFORCING STEEL SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:
    A. BOTTOM OF SLAB, 3"
    B. ELSEWHERE, 2"
12. DESIGN LOADS:
    EXTERIOR SURCHARGE 300psf
    INTERIOR SURCHARGE 75psf
    NATIVE SOIL 116psf
    CONCRETE SAND 130psf
    ALLOWABLE BEARING PRESSURE 4000psf

SCALE: 1/4"=1'-0"

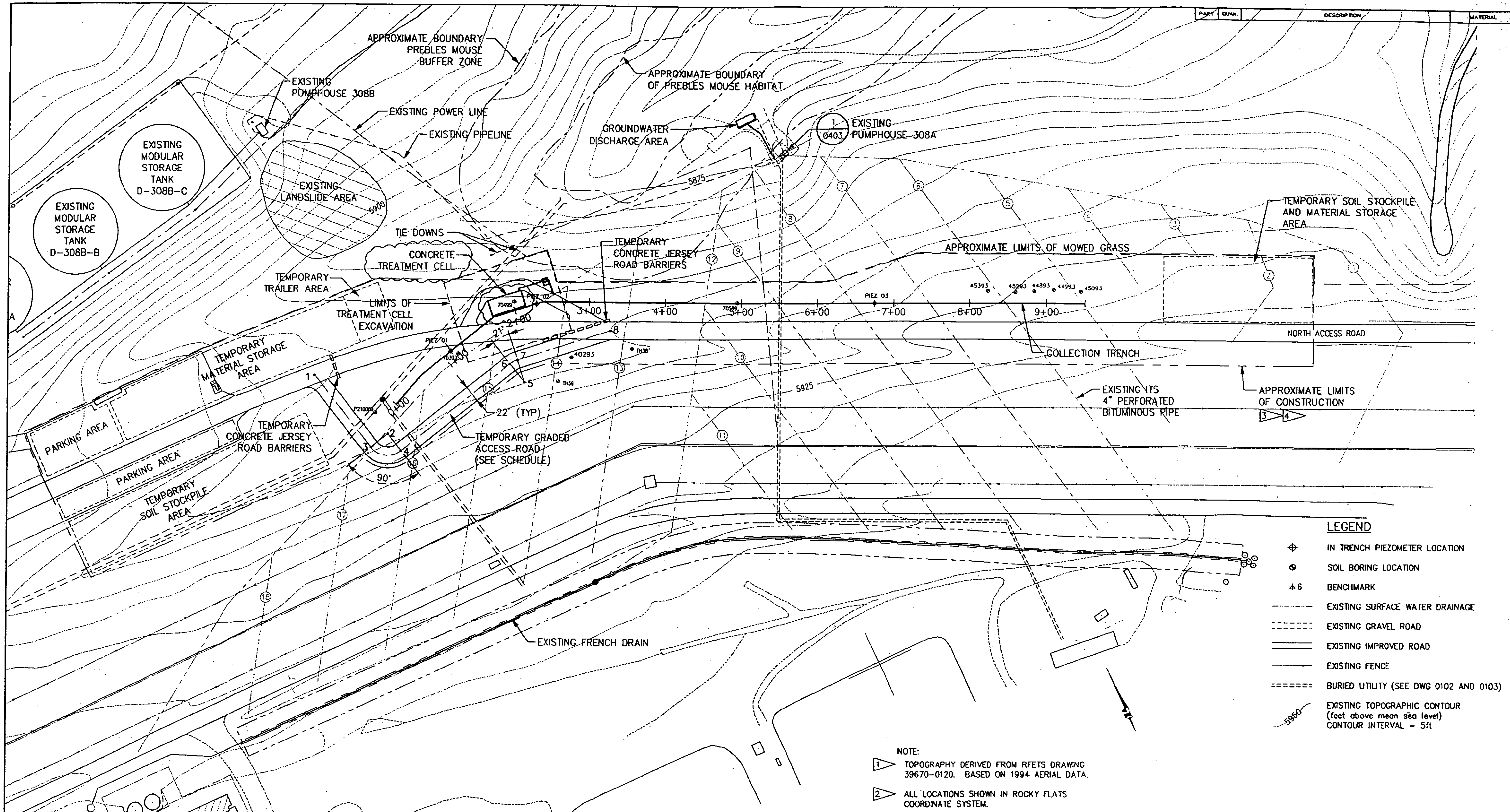
TREATMENT SYSTEM STRUCTURAL PLAN

SCALE: 1/4" = 1'-0"

Figure 2

Treatment Cell Details

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80403-8200



LEGEND

- IN TRENCH PIEZOMETER LOCATION
- SOIL BORING LOCATION
- 6 BENCHMARK
- EXISTING SURFACE WATER DRAINAGE
- EXISTING GRAVEL ROAD
- EXISTING IMPROVED ROAD
- EXISTING FENCE
- BURIED UTILITY (SEE DWG 0102 AND 0103)
- 5950 EXISTING TOPOGRAPHIC CONTOUR (feet above mean sea level) CONTOUR INTERVAL = 5ft

NOTE:

1. TOPOGRAPHY DERIVED FROM RFETS DRAWING 39670-0120. BASED ON 1994 AERIAL DATA.
2. ALL LOCATIONS SHOWN IN ROCKY FLATS COORDINATE SYSTEM.
3. MAINTAIN SURFACE WATER DIVERSION UPHILL OF LIMITS OF CONSTRUCTION.
4. MAINTAIN SILT FENCE FOR EROSION CONTROL DOWNHILL OF LIMITS OF CONSTRUCTION.

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60' 0 60'

SCALE: 1"=60'

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Figure 1

Groundwater System Locations

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80403-8200

26

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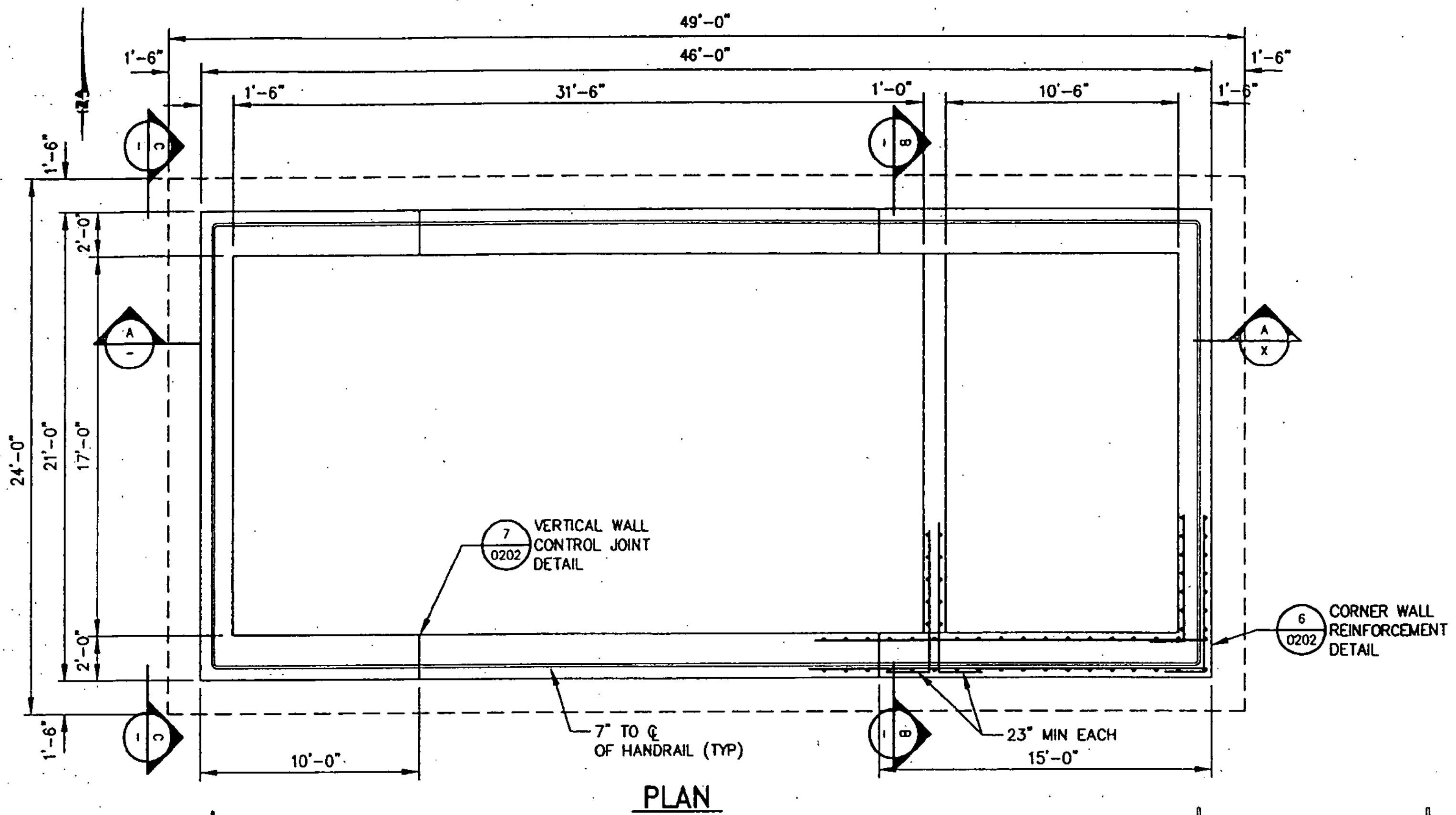

NOTES:

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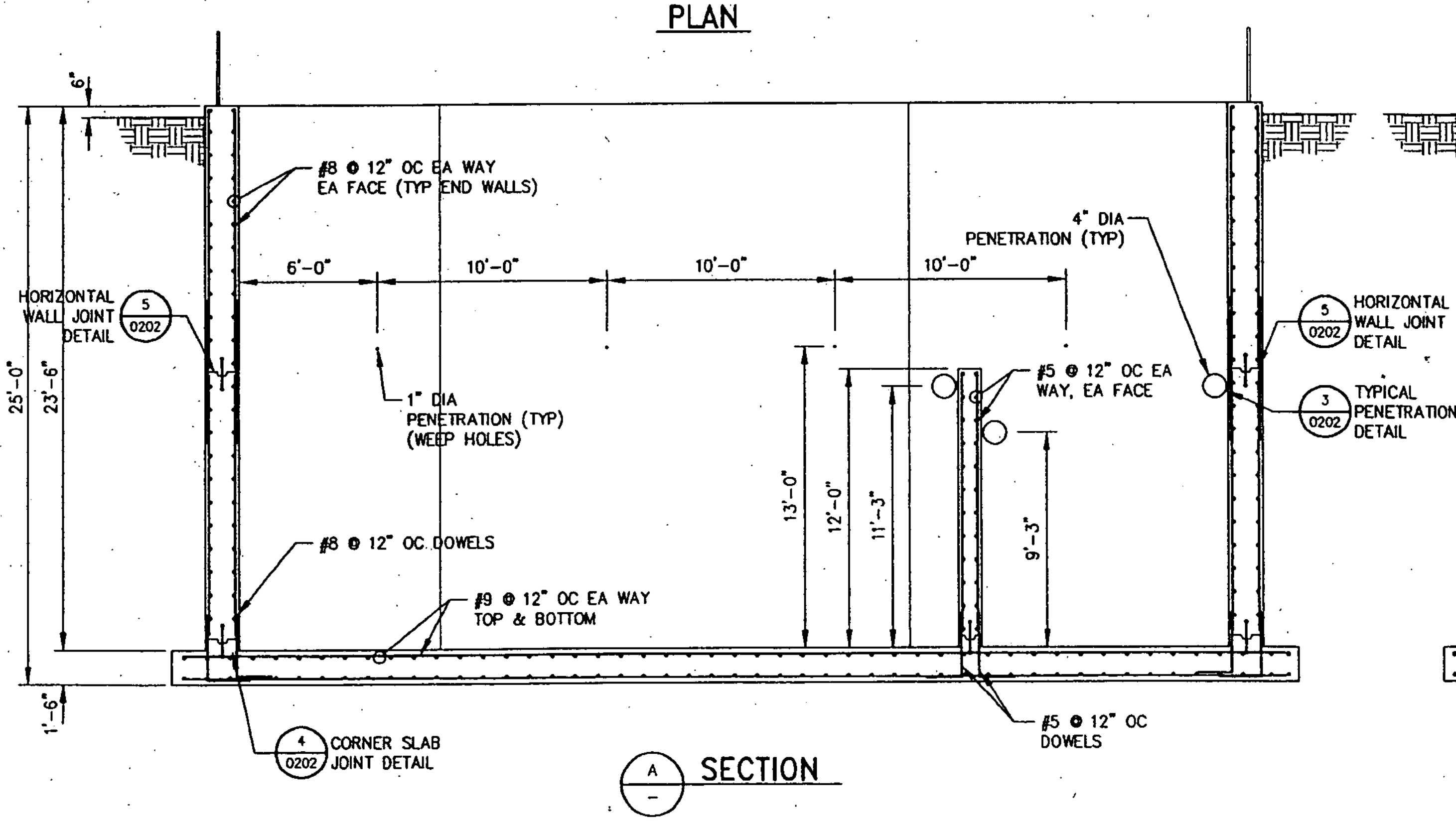
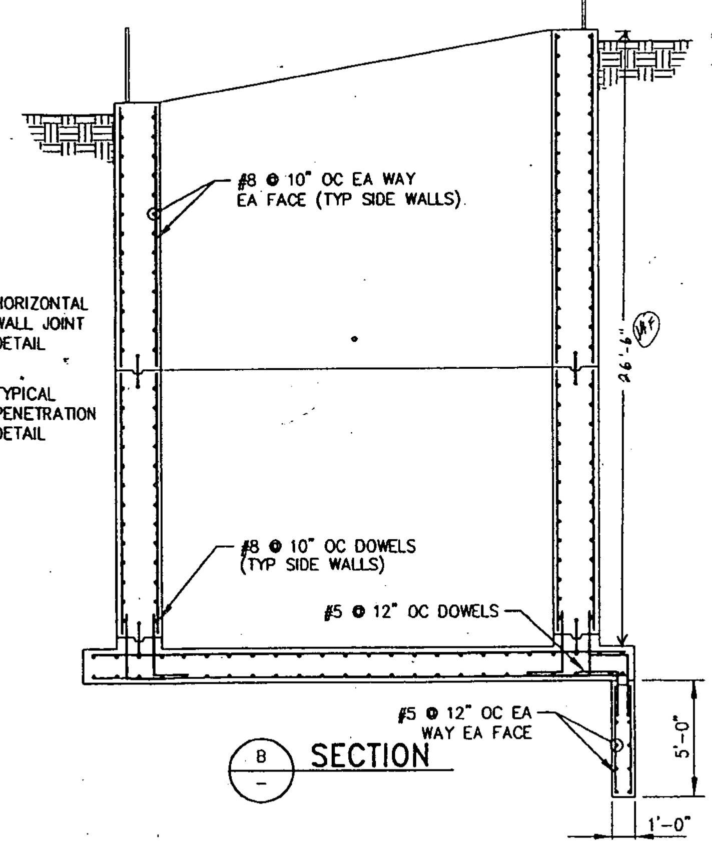
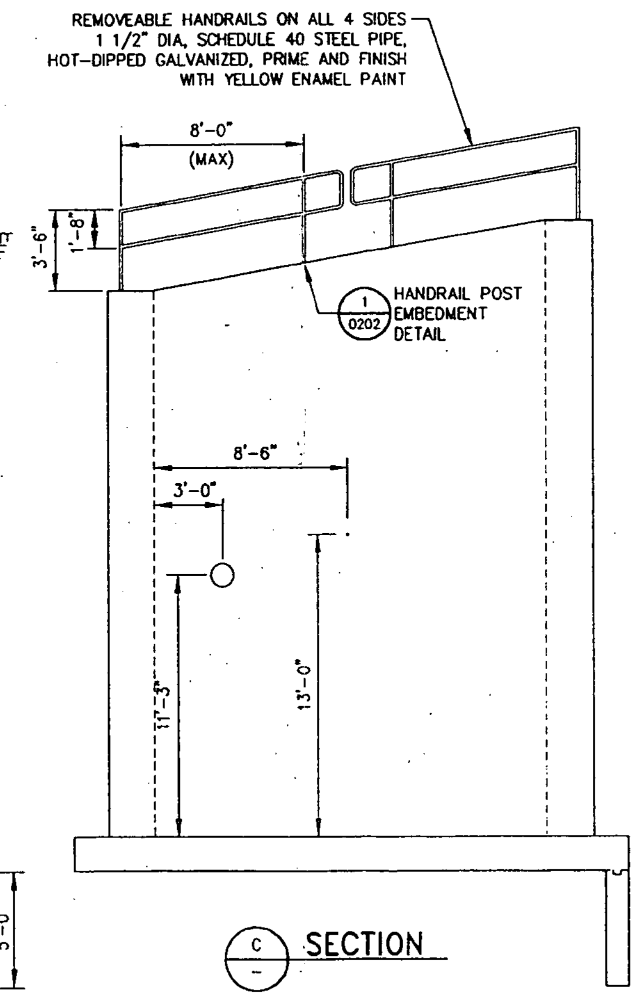
    INTERIOR SURCHARGE 75psf
    NATIVE SOIL 116psf
    CONCRETE SAND 130psf
    ALLOWABLE BEARING PRESSURE 4000psf

PART	QUAN.	DESCRIPTION	MATERIAL







4' 0 4'
SCALE: 1/4"=1'-0"

1 / 0105 TREATMENT SYSTEM STRUCTURAL PLAN
SCALE: 1/4" = 1'-0"

Figure 2

Treatment Cell Details

RMRS
Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, Colorado 80403-8200

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